Fire Manpower Utilization Study
Conducted for the City of Livermore,
the City of Pleasanton,
and the Valley Community Services District

Fire prevention Administration Livermore
    "   "   "   Pleasanton

by

Booz, Allen & Hamilton, Inc.

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OVERVIEW OF THE
CONDUCT AND RESULTS
OF THE FIRE MANPOWER
UTILIZATION STUDY

1. STUDY EFFORTS WERE DIRECTED AT IDENTIFYING
WAYS OF INCREASING FIRE FIGHTER PRODUCTIVITY AND
DEVELOPING STAFFING OPTIONS FOR PROVIDING
DESIRED SERVICE LEVELS

- Municipal administrators have traditionally viewed the fire
service as an area in which productivity improvements are
possible.

- Innovation in fire service staffing and manpower utilization
has been limited.

- Continuation of traditional fire service approaches may
prove increasingly costly for communities.

- Recognition of the likely impact of national attempts to
reduce the fire fighters' standard work week from 56 to
40 hours and increasing financial pressures led the three
communities to take a fresh look at fire service staffing
and manpower utilization.

- Major study objectives were two-fold:

    - Identify practical ways to keep fire fighters productively
    employed while they are present for duty.

    - Determine if there are realistic alternatives to tradi-
    tional staffing patterns which can provide communities
    adequate fire service levels and yet limit the amount
    of additional manpower requirements required to meet
    demands for service level increases.

2. THE PROJECT WAS CONDUCTED OVER A
SEVEN-MONTH PERIOD AND INCLUDED DETAILED
ANALYSIS OF HOW FIRE FIGHTERS CURRENTLY
UTILIZE AVAILABLE TIME

. The study environment was characterized by similarity
between the three neighboring communities.

- Neighboring communities with comparable structural,
grass and bush fire protection requirements

- Relatively small fire departments

- Substantial (30%-50%) portions of total municipal
budgets devoted to fire services

- Similar Insurance Services Office gradings

. Our analytical approach applied over a seven-month period
included:

- Detailed documentation of all phases of department
operations

- Conduct of time-logging exercise to determine how
fire fighters actually spent their time

- Survey of innovative fire service approaches being
tried across the county

3. MAJOR STUDY FINDINGS

. Exhibit I, following this page, shows results of time-logging
exercise.

- More than 50% of the average fire fighter's work week
involves non-productive time.

- Actual fire fighting occupies only a small portion of
the fire fighter's work week.

- Substantial portion of time are devoted to training

LIVERMORE

Activity	Firemen	Act. Lieut.	Liutenants	Bat. Chiefs	FPB	Steno/Clerk	Asst. Chief
. Fire Suppression & Salvage	1.8	.9	.5	1.7	.3	--	11.1
. Emergency Incidents	1.3	.7	.9	2.4	--	--	1.7
. False Alarms	.1	.3	.4	.1	--	--	--
- TOTAL ALARM RESPONSE	3.2	1.9	1.8	4.2	.3	--	12.8
- POST-FIRE CLEAN-UP	.3	--	.1	--	--	--	--
. Code Development & Enforcement	--	--	--	--	9.2	--	--
. Technical Fire Inspections	--	--	--	--	10.0	--	--
. Company Inspections	--	--	.2	--	1.6	--	--
. Weed Abatement	--	--	--	--	18.2	--	--
. Plan Checking	--	--	--	--	2.8	--	--
. Fire Investigations	--	--	--	--	12.8	--	--
- TOTAL FIRE PREVENTION	--	--	.2	--	54.6	--	--
- PRE FIRE PLANNING	.3	--	.1	--	.2	--	--
. Drills	3.6	3.5	3.5	--	--	--	--
. Classroom/Lecture	3.1	1.8	2.2	1.5	--	--	--
. Homework	3.3	5.6	3.0	--	--	--	--
. New Recruit Training	.2	--	--	--	--	--	1.0
- TOTAL FIRE TRAINING	10.2	10.9	8.7	1.5	--	--	1.0
. Apparatus Repair & Reconditioning	1.7	.3	.2	.9	.8	--	--
. Equipment Maintenance & Testing	1.6	--	.3	--	--	--	--
. Hydrant Maintenance & Testing	2.6	.8	1.3	--	--	--	--
. Routine Apparatus Maintenance	4.3	--	.4	--	.6	--	--
- TOTAL MAINTENANCE & TESTING	10.2	1.1	2.2	.9	1.4	--	--
. Interior Maintenance	6.1	1.9	2.9	--	--	--	--
. Grounds Maintenance	.7	--	1.1	--	--	--	--
- STATION HOUSEKEEPING	6.8	1.9	4.0	--	--	--	--
- DISPATCHING	.5	1.3	.1	--	--	.3	--
. General Supervision	.8	3.1	5.7	9.8	5.0	--	13.5
. Report Prep. & Record Keeping	2.3	7.2	8.8	9.6	12.6	11.2	13.0
. Planning, Research, Analysis	.2	1.2	3.1	3.9	8.9	1.3	11.3
. Filing, Typing, Clerical	.3	1.3	2.7	5.2	--	43.7	.5
. Personnel & Budget Control	.1	.4	.8	3.4	--	--	11.1
. Purchasing & Supplies	.1	--	.4	1.4	--	--	13.3
. Staff Support Activities	.5	8.4	1.4	4.3	2.2	--	12.0
- TOTAL ADMINISTRATION ACTIVITIES	4.3	21.6	22.9	37.6	28.7	56.2	74.7
. Eating, Sleeping, Coffee Breaks	45.3	41.9	42.0	47.3	9.6	10.7	2.7
. Reading, Relaxing, Television	9.1	7.7	11.4	7.1	.4	--	--
. Physical Fitness, Recreation	1.5	.5	.8	--	--	--	--
. Cooking, Shopping, Wash-up	1.5	.9	1.5	.4	--	1.0	--
- TOTAL STAND BY TIME	57.4	51.0	55.7	54.8	10.0	11.7	2.7
. Voter & Bicycle Registration	1.1	.9	1.0	--	--	--	--
. Public Information & Education	.8	--	.2	--	--	--	--
- TOTAL PUBLIC SERVICES	1.9	.9	1.2	--	--	--	--
- OTHER MISCELLANEOUS	4.9	9.4	3.0	1.0	4.8	31.8	8.8
- PHONE INTERRUPTIONS	(.7)	(2.0)	(1.2)	(1.5)	(4.3)	(3.7)	(4.8)
.. TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PLEASANTON

Activity	Firemen	Liutenants	Captains	Marshal
. Fire Suppression & Salvage	.9	.5	2.5	--
. Emergency Incidents	1.2	.8	1.2	--
. False Alarms	.1	.1	--	--
- TOTAL ALARM RESPONSE	2.2	1.4	3.7	--
- POST-FIRE CLEAN-UP	.7	.2	.5	--
. Code Development & Enforcement	--	--	--	12.3
. Technical Fire Inspections	--	--	--	3.5
. Company Inspections	1.6	.5	--	--
. Weed Abatement	--	--	--	19.0
. Plan Checking	--	--	--	2.5
. Fire Investigations	.2	--	.3	--
- TOTAL FIRE PREVENTION	1.8	.5	.3	37.3
- PRE FIRE PLANNING	1.8	1.5	--	--
. Drills	3.7	5.2	1.6	--
. Classroom/Lecture	4.2	2.5	3.6	--
. Homework	.9	2.2	1.0	--
. New Recruit Training	--	--	--	--
- TOTAL FIRE TRAINING	8.8	9.9	6.2	--
. Apparatus Repair & Reconditioning	1.2	1.2	.5	--
. Equipment Maintenance & Testing	2.0	.7	--	--
. Hydrant Maintenance & Testing	1.8	.9	1.0	--
. Routine Apparatus Maintenance	2.7	.3	--	--
- TOTAL MAINTENANCE & TESTING	7.7	3.1	1.5	--
. Interior Maintenance	5.4	5.3	.4	1.6
. Grounds Maintenance	.8	1.5	--	--
- STATION HOUSEKEEPING	6.2	6.8	.4	1.6
- DISPATCHING	--	--	--	--
. General Supervision	.1	.7	4.4	2.7
. Report Prep. & Record Keeping	.8	5.9	8.1	8.1
. Planning, Research, Analysis	1.2	1.7	.7	--
. Filing, Typing, Clerical	.2	2.0	1.0	18.3
. Personnel & Budget Control	.5	.6	.5	1.1
. Purchasing & Supplies	.5	1.3	--	--
. Staff Support Activities	1.4	1.2	13.5	2.9
- TOTAL ADMINISTRATION ACTIVITIES	4.7	13.4	28.2	32.6
. Eating, Sleeping, Coffee Breaks	46.8	45.3	47.1	12.6
. Reading, Relaxing, Television	8.9	9.1	6.1	--
. Physical Fitness, Recreation	2.0	.1	--	--
. Cooking, Shopping, Wash-up	5.8	6.2	1.0	--
- TOTAL STAND BY TIME	63.5	60.7	54.2	12.6
. Voter & Bicycle Registration	.4	.3	--	--
. Public Information & Education	.9	.6	1.7	5.6
- TOTAL PUBLIC SERVICES	1.3	.9	1.7	5.6
- OTHER MISCELLANEOUS	1.3	1.6	3.3	10.3
- PHONE INTERRUPTIONS	(.4)	(1.1)	(2.5)	(*)
.. TOTAL	100.0	100.0	100.0	100.0

VCSD

Activity	Firemen	Captains	Dispatchers
. Fire Suppression & Salvage	.5	.4	--
. Emergency Incidents	.7	1.2	--
. False Alarms	.1	.1	--
- TOTAL ALARM RESPONSE	1.3	1.7	--
- POST-FIRE CLEAN-UP	.4	.7	--
. Code Development & Enforcement	*	.2	--
. Technical Fire Inspections	.1	.6	--
. Company Inspections	--	--	--
. Weed Abatement	--	.9	--
. Plan Checking	.2	.5	--
. Fire Investigations	--	.3	--
- TOTAL FIRE PREVENTION	.3	2.5	--
- PRE FIRE PLANNING	.4	--	--
. Drills	1.5	1.1	.8
. Classroom/Lecture	7.6	5.0	.3
. Homework	3.2	3.3	--
. New Recruit Training	.3	--	--
- TOTAL FIRE TRAINING	12.6	9.4	1.1
. Apparatus Repair & Reconditioning	1.0	1.3	--
. Equipment Maintenance & Testing	--	--	2.4
. Hydrant Maintenance & Testing	1.2	--	--
. Routine Apparatus Maintenance	3.2	--	--
- TOTAL MAINTENANCE & TESTING	5.4	1.3	2.4
. Interior Maintenance	6.5	2.3	.4
. Grounds Maintenance	3.0	--	--
- STATION HOUSEKEEPING	9.5	2.3	.4
- DISPATCHING	.1	--	4.7
. General Supervision	.1	9.7	--
. Report Prep. & Record Keeping	.2	5.9	6.9
. Planning, Research, Analysis	.1	1.7	--
. Filing, Typing, Clerical	.3	2.1	15.1
. Personnel & Budget Control	--	.1	--
. Purchasing & Supplies	--	.4	--
. Staff Support Activities	*	.4	4.6
- TOTAL ADMINISTRATION ACTIVITIES	.7	20.3	26.6
. Eating, Sleeping, Coffee Breaks	46.2	51.2	45.3
. Reading, Relaxing, Television	10.1	6.7	15.1
. Physical Fitness, Recreation	4.1	.2	.6
. Cooking, Shopping, Wash-up	4.6	1.9	3.0
- TOTAL STAND BY TIME	65.0	60.0	64.0
. Voter & Bicycle Registration	.4	--	--
. Public Information & Education	.8	--	.7
- TOTAL PUBLIC SERVICES	1.2	--	.7
- OTHER MISCELLANEOUS	3.1	1.8	.1
- PHONE INTERRUPTIONS	(.2)	(--)	(2.3)
.. TOTAL	100.0	100.0	100.0

Note: Phone interruptions not included in total
* Less than .1%

EXHIBIT I(2)

Fire Manpower Utilization Study

CURRENT WEEKLY ACTIVITY DISTRIBUTION

Combined Twin Valley: Shift Personnel Only

	Fire Fighters Hrs/Wk	Lieutenants Hrs/Wk	Captains/Bat Chiefs Hrs/Wk	All Classes Hrs/Wk
Fire Suppression & Salvage	.6	.3	.8	
Emergency Incidents	.6	.4	.9	
False Alarms	.1	.2	.1	
- TOTAL ALARM RESPONSE	1.3	.9	1.8	1.3
- POST-FIRE CLEAN-UP	.3	.1	.2	.2
Code Development & Enforcement	--	--	.1	
Technical Fire Inspections	--	--	.1	
Company Inspections	.2	.2	--	
Weed Abatement	--	--	.1	
Plan Checking	.1	--	.1	
Fire Investigations	.1	--	.1	
- TOTAL FIRE PREVENTIONS	.4	.2	.5	.4
- PRE FIRE PLANNING	.4	.4	--	.3
Drills	1.5	2.5	.5	
Classroom/Lecture	2.8	1.3	1.9	
Homework	1.4	1.4	.8	
New Recruit Training	.1	--	--	
- TOTAL FIRE TRAINING	5.9	5.2	3.2	5.4
Apparatus Repair & Reconditioning	.7	.4	.5	
Equipment Maintenance & Testing	.7	.3	--	
Hydrant Maintenance & Testing	1.1	.6	.2	
Routine Apparatus Maintenance	1.9	.2	--	
- TOTAL MAINTENANCE & TESTING	4.4	1.5	.7	3.3
Interior Maintenance	3.4	2.3	.5	
Grounds Maintenance	.8	.7	--	
- STATION HOUSEKEEPING	4.2	3.0	.5	3.7
- DISPATCHING	.1	.1	--	.1
General Supervision	.2	1.8	4.5	
Report Prep. & Record Keeping	.6	4.1	4.4	
Planning, Research, Analysis	.3	1.3	1.2	
Filing, Typing, Clerical	.2	1.3	1.6	
Personnel & Budget Control	.1	.4	.7	
Purchasing Supplies	.1	.5	.3	
Staff Support Activities	.3	.7	3.4	
- TOTAL ADMINISTRATION ACTIVITIES	1.8	10.1	16.1	5.3
Eating, Sleeping, Coffee Breaks	25.8	24.4	27.1	
Reading, Relaxing, Television	5.3	5.8	3.7	
Physical Fitness, Recreation	1.4	.2	.1	
Cooking, Shopping, Wash-up	2.2	2.2	.6	
- TOTAL STAND BY TIME	34.7	32.6	31.5	33.8
Voter & Bicycle Registration	.3	.4	--	
Public Information & Education	.5	.2	.8	
- TOTAL PUBLIC SERVICES	.8	.6	.3	.7
- OTHER MISCELLANEOUS	1.7	1.3	1.2	1.5
- PHONE INTERRUPTIONS	(.2)	(.7)	(.7)	
TOTAL HOURS	56.0	56.0	56.0	56.0

• Although fire service staffing was maintained at constant levels around the clock, workload demands varied significantly by time of day.

• Innovative approaches to manpower utilization and staffing are not widespread in the fire service.

 - Most innovation in the area of technology and equipment

 - Little being tried that alters the 24-hour shift -- constant manning level approach that characterizes most departments

4. MAJOR STUDY RECOMMENDATIONS

Recommendations developed in three basic areas:

• Developing standards for utilization of individual fire fighter's time during the duty shift.

• Rethinking current staffing approaches and implementing a system that varies the levels of fire service manning according to workload and fire service requirements.

• Considering pooling fire service manpower among the three communities to facilitate implementation of the variable staffing approach.

(1) Several Constraints Governed the Development of Recommendations

• Operational requirements such as maintenance of fire service team integrity, continuous proximity to equipment, and accessibility to geographic response areas restrict the scope and kinds of non-fire service tasks to which fire fighters can be assigned.

• We were unable to identify legitimate community needs to which fire service manpower can be applied.

(2)   Targets for Utilization of the 24-Hour Shift
      Should Be Established

      .   Establish 11 hours as the overall productivity target.

      .   Reallocate time devoted to some duty categories:

          -   Station housekeeping
          -   Maintenance
          -   Equipment testing

      .   Establish duty schedules which formalize productivity
          targets.

      .   Evaluate the level of training effort required to
          maintain fire service skill levels.

(2)   Implement a Variable-Shift Staffing Approach Which
      Allocates Manpower Resources According to
      Workload and Fire Service Requirements

      .   Reduce manning during late evening and early morning
          hours when fire incident frequency is minimal (2300
          to 0800).

          -   Close station during these hours--one per
              community

      .   Revise shift scheduling practices to facilitate imple-
          mentation of the variable-shift staffing concept--fire
          fighters work a combination of 16-hour and 24-hour
          shifts.

          -   Requires a breakdown of the traditional three-
              "platoon" approach

          -   Requires more complex fire-duty scheduling--
              the approach is described in the attachment* to
              this section

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* Source: Final Report, Fire Manpower Utilization Study, City of
Livermore, City of Pleasanton, Valley Community Services District,
October 31, 1973.

• Benefits

　– Would enable the three communities to open and
　　man an additional station without increasing
　　staffing. In larger cities, would enable staffing
　　reductions.

　– If lower standard-hour work week is required
　　by national or state mandate, the variable-
　　staffing approach cost increases to maintain
　　acceptable service levels.

　– Adequate service levels can be maintained.

　　.. For major fires, the number of men and
　　　pieces of equipment initially responding to
　　　the fire call remains the same.

　　.. While response times might increase
　　　because of slightly increased travel
　　　requirements, light traffic during late
　　　evening and early morning hours would
　　　limit the amount of these increases.

• Disadvantages

　– Community reaction to closing stations during
　　various time periods might be adverse.

　– Backup personnel, available to respond to simul-
　　taneous incidents are reduced. However, analysis
　　of records indicates simultaneous incidents occur
　　very infrequently.

　– Labor groups might oppose.

(3) Establish a Three-Community Fire Service Manpower Pool
to Facilitate Implementation of the Variable-Staffing Concept

• Scheduling realities of variable-shift staffing, given
the manpower resources of the three study communi-
ties, require a manpower pool larger than that of each
individual department.

- Pilot test the concept by operaing planned new station in Livermore on a 10-hour per day basis.

- A Joint Powers Agreement between the three communities can be used to provide the legal basis to staff station with fire fighters from other communities.

ANALYSIS OF ALTERNATIVE STAFFING MODELS FOR MEETING TWIN VALLEY FIRE PROTECTION SERVICE LEVELS AT MINIMUM COST

As fire manpower comprises over 90% of total fire service costs in the Livermore-Amador Valley, substantial improvements in fire manpower productivity appear to be achievable through reductions in overall staffing if fire protection service levels are not significantly diminished. One vehicle for reducing overall staffing requirements while diminishing community service levels only nominally is variable staffing.

Variable staffing represents a significant departure from the traditional approach to fire staffing. As discussed in previous chapters, the traditional keystone to fire duty scheduling is the 24 hour shift. In order to staff one position for 24 hours per day, 7 days per week, 365 days per year, sufficient manpower must be provided to accommodate the particular number of average duty hours worked. For Livermore, Pleasanton and VCSD, all of which currently have a 56 hour average duty week, three men are required to staff each allocated position (168 total hours per week divided by 56 average duty hours per week). Variable staffing would not require constant manning of each allocated position. Variable staffing would vary company, station and overall manning levels throughout the day based upon designated fire service level objectives.

The concept of variable staffing targets required on-duty strength, in part, upon anticipated fire calls during any given 24 hour period. For periods during the day where historical experience indicates fire calls are at a minimum, a smaller level of staffing would be provided than during periods of expected higher incidence.

In this section, a number of alternative variable staffing models are presented. Advantages and disadvantages are analyzed, costs of each are calculated, comparisons with current staffing levels and costs are detailed and the cost impact on each alternative by the enactment of legislatively mandated reductions in the fire duty week is determined.

1. BUILDING A VARIABLE STAFFING MODEL

Constructing a variable staffing model for providing reasonable levels of fire protection in the Livermore-Amador Valley requires application of the same techniques as projecting manpower requirements under constant staffing principles. Briefly, the methodology is as follows:

- Determine service level objectives for each community in the Valley as defined by company manning levels required for each station during different periods of the day.

. Factor company manning requirements into appropriate
component ranks to be represented at each station.

. Total the number of manhours required per day for each
position aggregate by rank and divide through by 24 hours
to determine total manpower required per rank on a daily
basis.

. Multiply resulting daily manpower requirements per rank by
a factor representing the number of men required to fill
one position each week (determined by dividing total hours
per week by average number of duty hours worked per week)
to derive the total number of manpower required weekly at
minimum strength.

. Multiply minimum manpower requirements by a factor repre-
senting an allowance for all categories of leave accrued by
fire personnel to determine total manpower requirements for
maintaining a designated community service level objective.

In applying this methodology to Twin Valley fire departments, a
number of assumptions were made based upon current staffing levels,
anticipated staffing levels when a new fire station opens in Livermore dur-
ing April of 1974, and consensus service level objectives as described in
Exhibit X of Chapter II. The following section describes the application of
four alternative variable staffing models to the fire departments of
Livermore, Pleasanton and VCSD.

2. APPLYING ALTERNATIVE VARIABLE STAFFING MODELS TO THE LIVERMORE-AMADOR VALLEY

Each of the four alternative variable staffing models presented in
Exhibit XV, following this page, and discussed below is predicted on the
assumption that a reduced level of staffing during the early morning hours
will nonetheless maintain a reasonable level of fire protection services to
valley communities. As described in Chapter II, emergency incidents
during the hours from 2300 to 0800 in the morning have averaged less than
13% of total calls for any given 24 hour period. Structural fires, repre-
senting only 16% of total calls over a full 24 hour period, would reflect
only 2% of total calls for that nine-hour period. Thus, whether total
calls are figured at the 1971 level of 1685 per year for the three valley
communities, or at the current annual rate of about 2000 per year, the
expected frequency of a structural fire occurring during those nine hours
is only once every 9 or 10 days somewhere in the Twin Valley area or
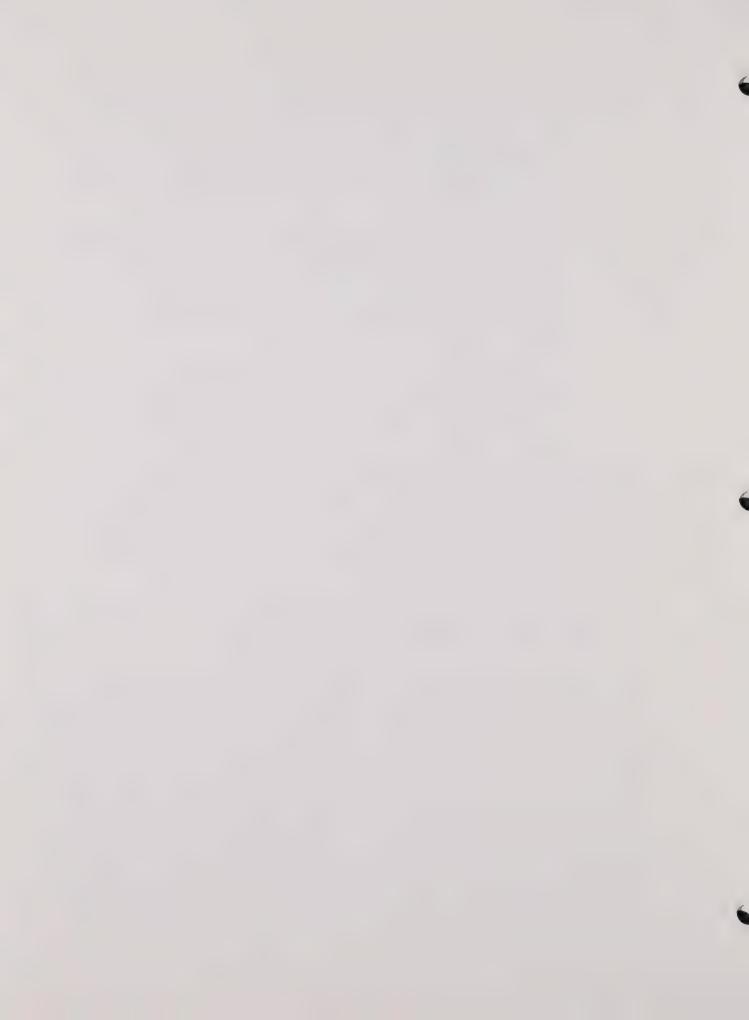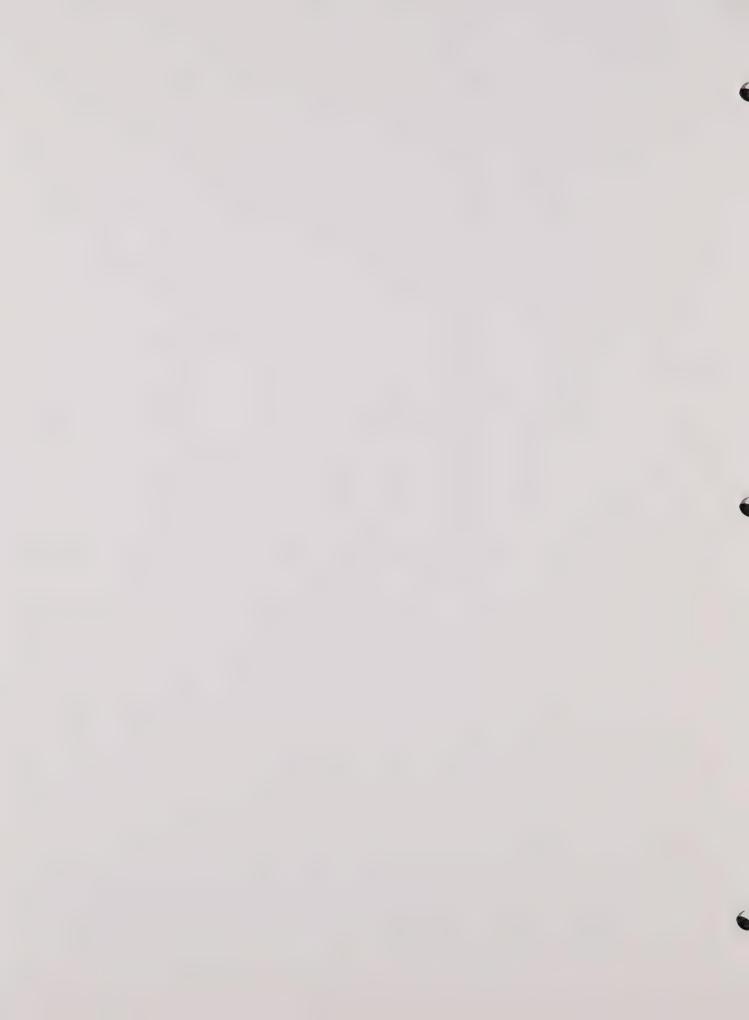once per month per community. Although data is not available on the

	Livermore				Pleasanton			VCSD		Total Daily	Total Manhours	Divide Total Manhours/Class	Minimum Manpower	Total Manpower	Minimum Manpower	Total Manpower	Minimum Manpower	Total Manpower
	#1	#2	#3	#4	#5	#6	#7	#8	#9	Minimum Strength	Required Per week	By Avg. Duty Week	Reqd. (56 hr. wk)	Reqd. (56 hr. wk)	Reqd (48 hr wk)	Reqd. (42 hr wk)	Reqd. (40 hr wk)	Reqd. (40 hr wk)

ALTERNATIVE #1

0730-2330

. Shift Officers	1				1				1	3	336							
. Company Officers		1	1	1		1	1	1		6	672							
. Firemen	3	2	2	1	3	1	1	2	3	18	2016	. Shift Officers	9	10	10.5	11	12.6	14
2330-0730												. Company Ofrs.	17	19	19.8	22	23.8	26
. Shift Officers	1				1				1	3	168	. Firemen	46	50	53.7	58	64.4	70
. Company Officers	1	1			1	1			1	5	280							
. Firemen	2	2			2	2			2	10	560							
											4032 ÷ Hrs/Wk =		72	79	84	91	100.8	110

ALTERNATIVE #2

0730-2330

. Shift Officers	1				1				1	3	315							
. Company Officers		1	1	1		1	1	1		6	630							
. Firemen	3	2	2	1	3	1	1	2	3	18	1890	. Shift Officers	9	10	10.5	11	12.6	14
2330-0730												. Company Ofrs.	16.9	19	19.7	22	23.6	26
. Shift Officers	1				1				1	3	189	. Firemen	45	49	52.5	57	63	68
. Company Officers	1	1			1	1			1	5	315							
. Firemen	2	2			2	2			2	10	630							
											3969 ÷ Hrs/Wk =		70.9	78	82.7	90	99.2	108

ALTERNATIVE #3

0730-2330

. Shift Officers	1				1				1	3	336							
. Company Officers	1	1	1	1	1	1	1	1	1	9	1008							
. Firemen	2	2	2	1	2	1	1	2	2	15	1680	. Shift Officers	9	10	10.5	11	12.6	14
2330-0730												. Company Ofrs.	23	25	26.8	29	32.2	35
. Shift Officers	1				1				1	3	168	. Firemen	40	44	46.7	51	56	61
. Company Officers	1	1			1	1			1	5	280							
. Firemen	2	2			2	2			2	10	560							
											4032 ÷ Hrs/Wk =		72	79	84	91	100.8	110

ALTERNATIVE #4

0730-2330

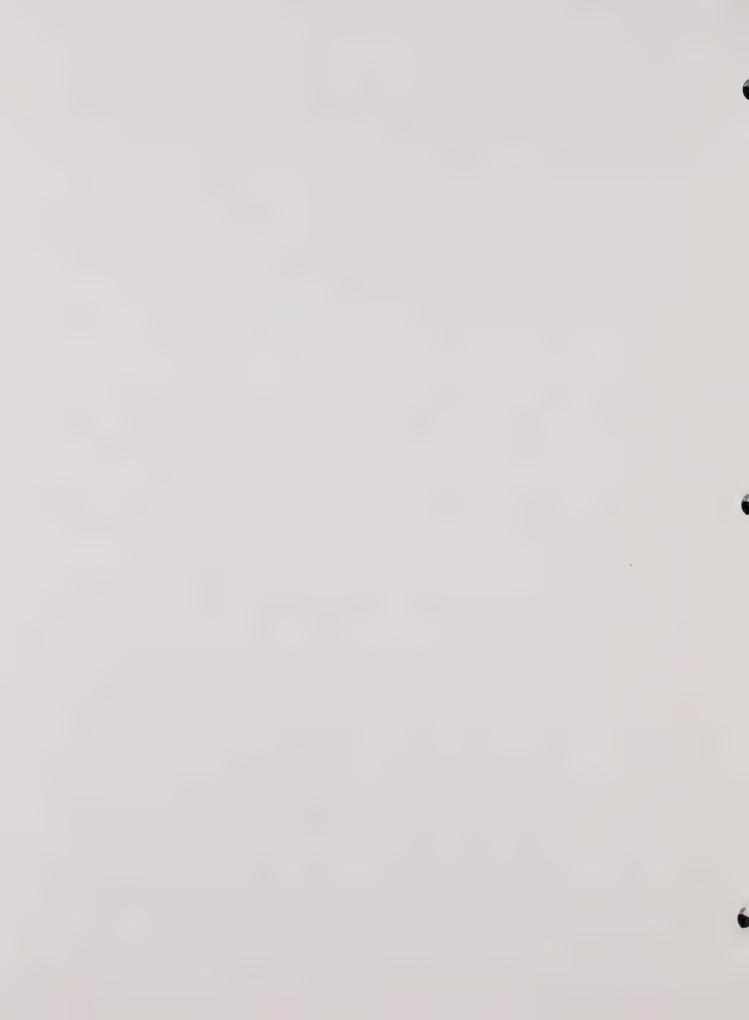|																		
. Shift Officers	1				1				1	3	336							
. Company Officers	1	1	1	1	1	1	1	1	1	9	1008							
. Firemen	2	2	2	2	2	2	2	2	2	18	2016	. Shift Officers	9	10	10.5	11	12.6	14
2330-0730												. Company Ofrs.	23	25	26.8	29	32.2	35
. Shift Officers	1				1				1	3	168	. Firemen	46	50	53.7	58	64.4	70
. Company Officers	1	1			1	1			1	5	280							
. Firemen	2	2			2	2			2	10	560							
											4368 ÷ Hrs/Wk =		78	85	91	98	109.2	119

percentage of structural fires sustaining considerable fire loss, clearly frequency expectations for those would be even less. It would be nearly impossible to precisely quantify the risk implicitly assumed which could be attributable to reduced staffing levels during the early morning hours, but the following factors must certainly be considered:

- Response time during early morning hours would be quicker due to lack of traffic congestion, although some incremental time is usually necessary for sleeping fire fighters to awaken, prepare for response and get rolling. In addition, fire officials indicate that the time it takes to detect a fire and notify the department is more prolonged at night. Moreover, time delays might compound the normal drop in efficiency during the hours of darkness at which time all phases of fire suppression become more difficult due to limited visibility.

- Operating tactics during those hours would not change appreciably so that irrespective of the staffing alternative applied, a minimum of two engine companies (each comprising three men: two fire fighters and one lieutenant) would respond to all major fires in addition to the shift commander. Thus, a minimum of seven men would converge at the scene of a fire on a first response basis compared with the current levels of eight in Livermore, five or six in Pleasanton and seven in VCSD for all hours of the day.

In addition to incremental risks, however minimal, which may be attributable to reduced staffing levels, some other disadvantages of each variable staffing alternative are apparent:

- Each alternative requires the closing of one station within each community during the early morning hours when reduced staffing is in effect. Station closings, no matter how reasonable or warranted, induce emotional opposition from residents, tax payers and organized fire fighter groups alike. The charge is often made that station closures constitute unequal fire protection service levels within a community and are, therefore, unfair. In reality, however, the result of fire station location decisions provide certain residents with better fire protection services (as reflected in response times) than others anyway. The closing of three stations for 8 hours each day will require an adjustment of first-in response districts, inevitably increasing response times to certain areas of each community, but overall average

response times should not be expected to increase appreciably
through careful response assignment planning.

- Under variable staffing there would be reduced backup protec-
tion available on an immediate basis as currently exists. Rou-
tine single engine response to resuscitator and other minor
calls would reduce overall coverage and initial response capa-
bilities for major incidents. This suggests increased reliance
on recalls and call-up of volunteers to meet backup require-
ments. To free engine companies for major incident response,
valley communities might wish to consider a limited flying
squad program for the early morning hours to respond to all
resuscitation and vehicular calls.

- Variable staffing will undoubtably generate considerable
opposition among organized fire fighter groups. Officials of
the three valley locals report considerable disenchantment with
the concept of variable staffing. It is perceived as threatening
moonlighting opportunities, potentially eliminating jobs and
reducing overall fire protection levels in the community. Var-
iable staffing should not appreciably affect moonlighting oppor-
tunities--as described later in this chapter, fire fighters would
be on duty 8 shifts every 21 days instead of the current 7 out of
21. And as Exhibit XV confirms, no elimination of jobs would
be indicated by any of the 4 alternative variable staffing models.
It is true, however, that fire protection service levels would
be reduced to the degree that some incremental risk may be
attributable to reduced overall manning during the early morn-
ing hours.

- Variable staffing destroys the symmetry of the three-platoon
system common to most fire departments in California. In
reality, however, there is nothing sacred about the three-
platoon system and fire departments in many eastern and
midwestern municipalities do not use it anyway. In Pittsburgh,
for instance, 13 equally-represented "fire groups" are sched-
uled systematically through a 13-day cycle with four days on
duty and nine days off. In New York City, 50 groups are
scheduled throughout each duty cycle.

- Variable staffing may make fire duty scheduling somewhat
more complex and, consequently, more difficult to under-
stand. Duty cycles are determined by the number of duty
periods worked before a schedule repeats itself. Depending
on the average number of duty hours worked per week

and the particular staffing and platoon system (or its variations) employed, fire duty cycles can range from two days to as long as 294 days (City of Philadelphia) in length. Although more cumbersome to visualize, lengthy fire duty cycles are in reality no more complex to schedule one man through than the basic three out of nine concept. The difficulties apparent are in devising appropriate common denominators to yield workable sub-groups for scheduling purposes and in dealing with fractions of duty weeks which can theoretically occur depending upon the number of required man-hours per duty cycle.

Despite these disadvantages, significant cost savings achievable under variable staffing principles are sufficiently compelling to warrant recommending the consideration of applying one of the following four alternative variable staffing models to Twin Valley fire departments. It should also be noted that, for purposes of analysis, the models presented employ the "manpower pooling" arrangement discussed in the following section although somewhat reduced benefits are theoretically achievable under single department application as well.

(1)   Alternative #1

Alternative #1 accepts, at minimum strength, the present level and rank configuration of company manning at each station in Livermore, Pleasanton and VCSD for the 16 hour period from 0730 to 2330 with the following exceptions:

.   The opening of a fourth fire station in Livermore during April of 1974 has been anticipated by allocating current and expected additional manpower to accommodate resulting modifications in manning requirements.

.   The provision of a single position for the rank of Lieutenant at VCSD where currently none exists.

.   The model does not provide at minimum strength, for the 4th Captain in VCSD and the 7th Lieutenant in Pleasanton.

Manning requirements during the period from 2330 to 0730 reflect the following:

. Discontinuing operations of one station in each community during those eight hours, tentatively station #3 in Livermore, #3 in Pleasanton and #1 in VCSD. An acceptable, though somewhat less favorable, alternative would be closing stations #3 in Livermore, #2 in Pleasanton, and #2 in VCSD. With this station configuration, all areas of the three communities are covered on a first response basis with dual engine response capabilities, assuming automatic aid between Pleasanton and VCSD for incidents occurring in the northern sector of Pleasanton and all of VCSD.

. Opening Livermores new station #4 only as a 16 hour operation from the beginning, thereby circumventing emotional opposition to a "station closing".

. A minimum three-man company assigned to the five operating stations at all times for that eight hour period to provide adequate immediate response capabilities to major fires.

. A shift commander for each community and one company officer (i.e., Lieutenant or Acting Lieutenant) per company.

Minimum daily manpower requirements are determined as follows:

. Three shift commanders for 16 hours plus three shift commanders for eight hours yields three shift commanders required per day.

. Six Lieutenants for 16 hours plus five Lieutenants for eight hours yields 5.67 Lieutenants required per day.

. 18 Fire Fighters for 16 hours plus 10 Fire Fighters for eight hours yields 15.33 Fire Fighters required per day.

Minimum manpower requirements per week would thus equal minimum daily requirements times 168 hours per week divided by 56 average duty hours per week or 9 shift commanders, 17 Lieutenants and 46 Fire Fighters.

The factor for leave allowances can be determined by applying historical experience data from the three jurisdictions. As Table 6 demonstrates, an acceptable average leave allowance factor for the three departments would be 9.4 shifts out of 121, 667 shifts per year or about 8.33%.
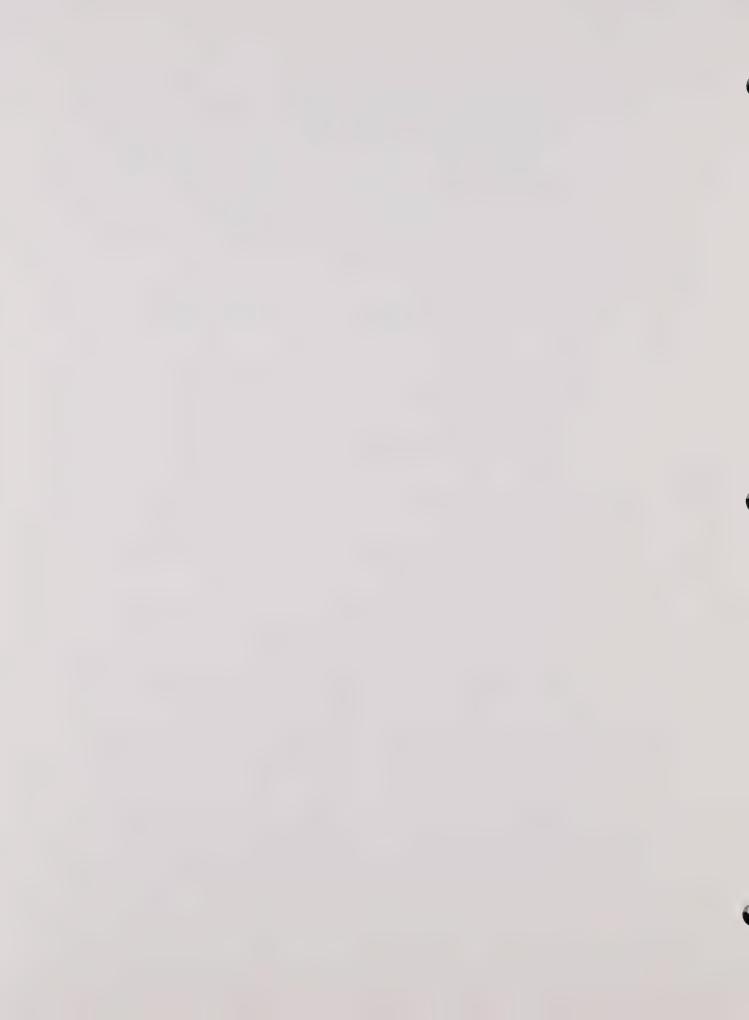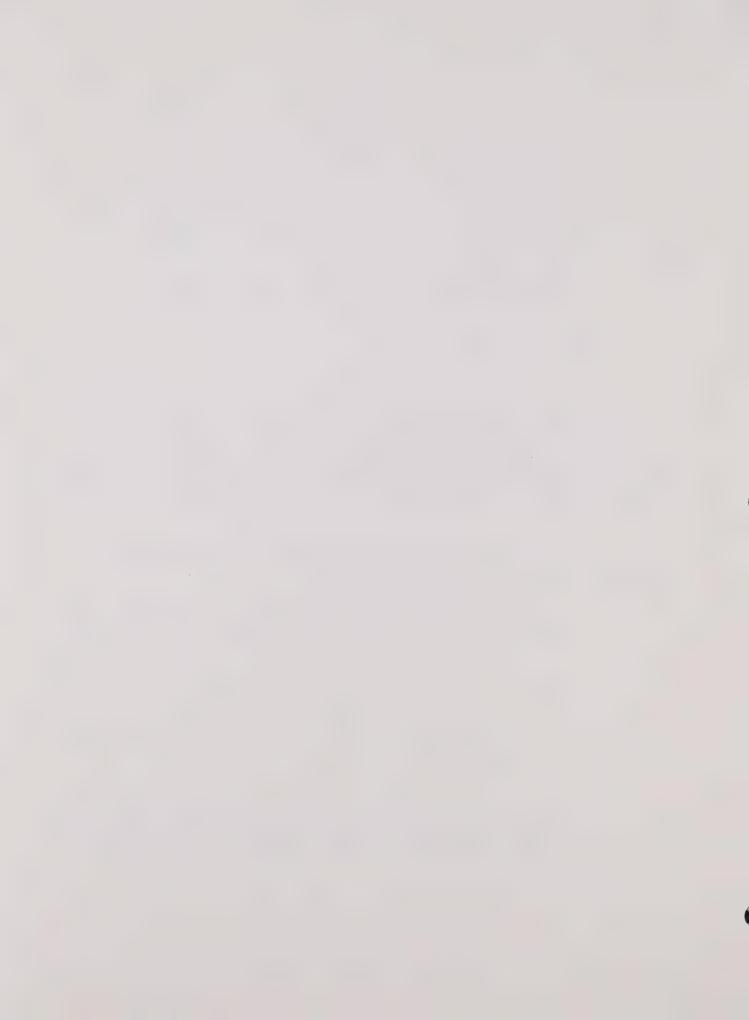
TABLE 6

	Livermore	Pleasanton	VCSD
• Average shifts/year	121.667	121.667	121.667
• Less: (average usage)			
-vacations	5.486	4.958	5.900
-sick leave	4.000	3.700	4.000
-injury leave	N.A.	.316	N.A.
-other leave	N.A.	N.A.	N.A.
Total Leave	9.486	8.658	9.000
• Total average manpower availability	112.811	112.693	111.767

Note: N.A. indicates data not available

Applying the leave allowance factor to minimum strength manpower requirements, yields total staffing requirements of 10 shift commanders, 19 Lieutenants and 50 Fire Fighters, assuming a 56 hour average duty week. For analysis purposes, the same methodology was applied using 48- and 40-hour average duty weeks to yield respective manpower requirements of 11 and 14 shift commanders, 22 and 26 Lieutenants and 58 and 70 Fire Fighters.

In devising a fire duty schedule to accommodate Alternative #1, the following methodology should be applied:

. Convert the minimum strength manning requirements from 16 and 8 hour increments to equivalent 16 and 24 hour periods:

- 3 shift commanders for 16 hours plus 3 for 8 = 3 for 24

- 6 Lieutenants for 16 plus 5 for 8 = 5 for 24 plus 1 for 16

- 18 Fire Fighters for 16 plus 10 for 8 = 10 for 24 plus 8 for 16

. Determine the total daily number of man-hours required per rank at minimum strength and aggregate Lieutenants and Fire Fighters to yield a combined total for company members:

- 3 shift commanders for 16 hours plus 3 for 8 = 72 man-hours

- 5 Lieutenants for 24 hours plus 1 for 16 = 136 man-hours

- 10 Fire Fighters for 24 hours plus 8 for 16 = 368 man-hours

- 15 company members for 24 hours plus 9 for 16 = 504 man-hours

. Multiply the total daily number of man-hours required for shift officers and company members at minimum strength by a factor representing the number of average duty weeks in one full calendar week and divide through by 24 hours to derive the total number of days necessary for one individual to complete the equivalent of the daily man-hour requirement per rank at the normal rate of average hours worked per week. This figure represents the duration of the appropriate duty cycle for each rank.

- 72 shift officer man-hours X 168 hours divided by 56 hours = 216 man-hours divided by 24 hours/day = 9 days

- 504 company member man-hours X 168/56 = 1512 man-hours divided by 24 hours/day = 63 days

. Factor the ratio of the total number of on-duty shifts required per rank (as determined from the variable staffing model) to the number of days in a duty cycle into its lowest common denominator to derive the simplest possible duty schedule pattern.

- 3 out of 9 days is equivalent to 1 on-duty day out of 3 for shift officers

- 15 24-hour shifts plus 9 16-hour shifts out of 63 days is equivalent to 5 24-hour shifts plus 3 16-hour shifts every 21 days (or 3 weeks) for company members

. Determine the lowest common denominator from the ratio of the total number of men required per rank to the length in days of the simplest duty schedule pattern to derive an appropriate number of members per platoon or sub-set for scheduling purposes:

- 9 to 3 yields a workable set of 3 shift commanders for each of 3 groups

- 63 to 21 yields a workable group of 3 company members for each of 21 groups

. Schedule one group through its simplest duty cycle:

- Shift Commanders: 1 24-hour shift every 3 days = XOO

- Company members: 5 24-hour shifts + 3 16-hour shifts every 21 days = XOYOXOYOXOOOXOYOXOOOO (where X = on duty 24 hour shift, Y = on duty 16 hour shift and O = off duty)

. Plot a master schedule for all groups per duty cycle.

- Shift Commanders: Duty schedule for 21 days plotted as in Table 7 below for groups 1, 2 and 3

TABLE 7

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Week 1	1	2	3	1	2	3	1
Week 2	2	3	1	2	3	1	2
Week 3	3	1	2	3	1	2	3

- Company members: Duty schedule for 21 days plotted as in Exhibit XVI, following this page, for groups 1 through 21.

. Allocate excess manpower available from allowance for leave factor to regular groups by spreading available manpower over as many working shifts as possible in order to absorb scheduled and un-scheduled leave requirements.

- 1 additional shift commander can be scheduled with any group or assigned to 40 hr/wk staff duty

- 2 additional Lieutenants and 4 additional Fire Fighters can be scheduled as indicated in Exhibit XVI

EXHIBIT XVI

Fire Manpower Utilization Study

MASTER DUTY SCHEDULE FOR LIEUTENANTS AND
FIRE FIGHTERS UNDER ALTERNATIVE #1

Day:/Group:	1*	2*	3*	4*	5*	6*	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Week 1 M	24					24		16		24				24		16		24		16	
T		24					24		16		24				24		16		24		16
W	16		24					24		16		24				24		16		24	
Th		16		24					24		16		24				24		16		24
F	24		16		24					24		16		24				24		16	
Sa		24		16		24						24		16		24			24		16
S	16		24		16		24						24		16		24			24	
Week 2 M		16		24		16		24						24		16		24			24
T	24		16		24		16		24						24		16		24		
W		24		16		24		16		24						24		16		24	
Th			24		16		24		16		24						24		16		24
F				24		16		24		16		24						24		16	24
Sa	24					24		16		24		16	24					24		16	
S		24				24		16		24		16	24						24		16
Week 3 M	16		24				24		16		24		16	24						24	
T		16		24				24		16		24		16		24					24
W	24		16		24				24		16		24		16		24				
Th		24		16		24					24		16		24		16		24		
F			24		16		24					24		16		24		16		24	
Sa				24		16		24					24		16		24		16		24
S					24		16		24				24		16		24		16		24

Note: * = Allocated one additional company member per group

Every 21 days: 8 days are scheduled with 3 additional company members
11 days are scheduled with 2 additional company members
2 days are scheduled with 1 additional company member

(2)   Alternative #2

Alternative #2 accepts the same daily minimum staffing requirements as Alternative #1 with one exception: the number of hours of variable staffing is increased by one hour to the nine hour period from 2230 at night to 0730 the next morning. Resulting manpower requirements are not appreciably different; however, over a week's time, one less Fire Fighter would be required. It is interesting to note that as the number of hours on reduced staffing are increased, required manpower is reduced commensurately, but as a step function due to the reality of dealing in "whole" men.

Overall staffing requirements under Alternative #2 would run 10, 11 and 14 for shift commanders; 19, 22 and 26 for Lieutenants and 49, 57 and 68 for Fire Fighters under 56, 48 and 40 hour average duty weeks respectively.

(3)   Alternative #3

Alternative #3 maintains the same overall number of staff required as in Alternative #1 but modifies the rank configuration somewhat to permit one Lieutenant on duty at each station to act as company officer at all times. Resulting overall manpower requirements run 10, 11 and 14 for shift commanders; 25, 29 and 35 for Lieutenants and 44, 51 and 61 for Fire Fighters given 56, 48 and 40 hour average duty weeks respectively.

(4)   Alternative #4

Alternative #4 increases the number of men on-duty during the 0730-2330 period of the day to permit one full Lieutenant per company at all times, as well as upgrading all companies in the valley to a minimum three man complement. Staffing for 2330-0730 period would remain the same as for the other three alternatives. Resulting manpower requirements total 10, 11 and 14 for shift commanders; 25, 29 and 35 for Lieutenants and 50, 58 and 70 for Fire Fighters, given 56, 48 and 40 hour duty weeks respectively.

3.   SIGNIFICANT COST SAVINGS ARE ACHIEVABLE THROUGH VARIABLE STAFFING

Adoption of three out of the four alternative variable staffing models presented above would result in considerable cost savings to the communities of Livermore, Pleasanton and VCSD for the support of fire protection operations.

In determining relative costs per man of supporting the three basic operating ranks of fire personnel, salary and fringe benefit data were incorporated as in Exhibit XVII. For purposes of analysis, Pleasanton and VCSD personnel were calculated at their presently effective rates while Livermore costs were calculated as of February 1, 1974 when the final stage of the recently executed contract agreement goes into effect. Costs for the various ranks were calculated and averaged by weighting appropriately for varying numbers of men per rank in each community to determine average Twin Valley annual personnel costs of $16,674.48 for Fire Fighters, $18,882.96 for Lieutenants and $20,417.28 for Captains and Battalion Chiefs.

Using these annual figures per rank, each alternative variable staffing model was costed out as in Exhibit XVIII. Resulting total costs of each staffing pattern for fire protection in the Livermore-Amador Valley (assuming a 56-hour average duty week), when compared with current costs of operational staffing as depicted in Table 8, below, yield the following conclusions:

- Adopting Alternative #1 will save $58,771.68

- Adopting Alternative #2 will save $75,446.16

- Adopting Alternative #3 will save $45,520.80

- Adopting Alternative #4 will cost an additional $54,526.08

It should be noted that "current" costs displayed in Table 8 include the anticipated additional four Fire Fighters to be added in Livermore in April 1974. Savings over actual present staffing costs would accrue only if Alternative #2 were to be adopted.

TABLE 8

Ranks (Operating Strength Only)	Livermore		Pleasanton		VCSD		Combined Twin Valley	
	No.	Total $	No.	Total $	No.	Total $	No.	Total $
• Bat. Chiefs/Captions	3	64,673.28	3	62,373.60	4	75,612.00	10	202,658.88
• Lieutenants	9	169,608.60	7	132,443.64	0	---	16	302,052.24
• Fire Fighters	26	435,823.44	14	235,801.44	17	279,108.72	57	905,733.60
Total	38	670,105.32	24	430,618.68	21	354,720.72	83	1,455,444.72

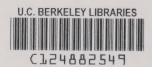|	Firemen			Lieutenants		Captains/Battalion Chiefs		
	Livermore	Pleasanton	VCSD	Livermore	Pleasanton	Livermore	Pleasanton	VCSD
. Base Rate	$1129.00	$1129.00	$1041.00	$1274.00	$1274.00	$1463.00	$1405.00	$1266.00
- Hourly equivalent	(6.51)	(6.51)	(6.01)	(7.35)	(7.35)	(8.44)	(8.11)	(7.30)
. Medical	33.50	34.69	52.42	33.50	34.69	33.50	34.69	52.42
. Retirement	100.84	96.13	72.89	113.79	108.48	130.68	119.64	90.95
. Social Security			49.50					
. Workman's Compensation	53.57	47.21	40.29	60.68	53.50	69.63	58.78	49.00
. Dental Insurance			9.17					
. Life Insurance	.52	4.10	6.00	.52	4.10	.52	4.10	6.00
. Disability Insurance		10.73			10.73		10.73	
. Uniform Allowance	12.50	8.33	9.19	12.50	8.33	12.50	8.33	9.17
. Holiday Pay	66.84	73.39	83.74	75.46	82.88	86.65	91.33	101.71
- Total Cost/Man	$1396.87	$1403.58	$1368.18	$1570.45	$1576.71	$1796.48	$1732.60	$1575.25
.. Hourly Equiv.	(8.06)	(8.10)	(7.89)	(9.06)	(9.10)	(10.36)	(10.00)	(9.09)
- Average Cost/Mo.		1389.54			1573.58		1701.44	
.. Hourly Equiv.		(8.02)			(9.08)		(9.82)	
- Annual Avg. Cost		16,674.48			18,882.96		20,417.28	
- Annual Cost per Position								
.. 56 hr/wk, x - 3.25		54,192.06			61,369.62		66,356.16	
.. 48 hr/wk, x = 3.9		65,030.47			73,643.54		79,627.39	
.. 40 hr/wk, x = 4.55		75,868.88			85,917.47		92,898.62	
• Under mandated reductions in the fire duty week								
- Avg Base Rate/Mo.		1129.00			1274.00		1378.00	
..Hr rate @56-48-40 hrs/wk	(4.65)	(5.43)	(6.51)	(5.25)	(6.13) (7.35)	(5.68)	(6.63) (7.95)	
- 1 hr ovt/wk @ each rate x 1.5/yr	362.70	423.54	507.78	409.50	477.75 573.30	443.04	516.75 620.10	
- 1 hr ovt/wk per position	1178.78	1376.50	1650.29	1330.88	1552.69 1863.23	1439.88	1679.44 2015.33	
- Cost/hr of reducing work week	1345.80	1354.80	1354.80	1534.24	1534.24 1534.24	1658.80	1658.90 1658.90	
.. Savings(cost) per hour of reducing work wk	($176.02)	$21.70	$295.49	($203.36)	$18.45 $328.99	($219.02)	$20.54 $356.43	

4.   COST IMPLICATIONS OF THE 40- AND 48-HOUR DUTY WEEK

Reducing the fire duty week from 56 to 48 or 40 hours and maintaining equivalent fire protection service levels in the three communities would result in a considerable increase in overall operational staffing costs. The current level of staffing (83 operating personnel effective April 1974) would theoretically have to be increased by 2 men for each hour that the average fire duty week was reduced. Assuming staff increases by rank would remain proportional to the existing rank configuration, resulting estimated staffing levels and costs are as displayed in Table 9.

TABLE 9

	56-Hour Week		48-Hour Week		40-Hour Week	
	No.	Cost	No.	Cost	No.	Cost
. Bat. Chiefs/Captains	10	202,659	12	243,191	14	283,723
. Lieutenants	16	302,052	19	353,687	22	415,322
. Fire Fighters	57	950,734	68	1,134,209	80	1,334,363
- Total	83	$1,455,445	99	$1,736,087	116	$2,033,408
.. Current data			83	1,455,445	83	1,455,445
.. Increase			16	$280,642	33	$577,963

Cost implications of the 40- and 48-hour duty week on the four alternative variable staffing models are presented in Exhibit XVIII. It should also be noted that other staffing arrangements based on a 40- or 48-hour week may be devised using similar variable staffing principles. Increased manpower utilization is theoretically achievable under a 40-hour work week system, for instance, when fire personnel are expected to remain awake and productive for each of five 8-hour shifts per week. However, the substantial increase in costs resulting from the additional manpower requirements effectively discourage reductions in the average duty week when real cost savings or avoidance opportunities through increased manpower utilization cannot be specifically identified. If state or federal legislation mandates reductions in the duty week, however, valley communities may wish to consider a 40- or 48-hour work week.